*Now PART OF SPEC.*

Table 1

| Acc # 1-Vehicle Motion |
| --- |
| Acc # 2-Wheel Angle |
| Light Sensor - Ambient |
| Temp Sensor - Ambient |
| Sounder |
| Mark Button |

Table 2

W - Wheel Rotation Angle
X - Measured component of g in sensor axis (m/s/s)
K wheel - Sensor scaling factor (mm/s/s/bit)
g - Gravity 9.81 m/s/s
g - Gravity Vector Component in wheel Plane

$$\text{Sin } W = X / g$$

$$X = k \text{ wheel} / 1000 \times (Ch(1) - ZeroWheel) \times 1/Cos(Alpha)$$

$$\text{Sin } W = k \text{ wheel} / (1000 \times g) \times (Ch(1) - ZeroWheel) \times (1/Cos(Alpha))$$

$$W + ArcSin [ Kwheel /(1000 \times g) \times (Ch(1) - ZeroWheel) \times 1/Cos(Alpha)]$$

Table 3

$$\text{RMS Steering Angle - } R(Deg) = \sqrt{\frac{\sum Wheel[n]^2}{n}}$$

Table 4

| Bound Check | |
| --- | --- |
| W Limit- < W < W Limit+ | Steering Mode=Corrective |
| W < W Limit- | Steering Mode=Active |
| W > W Limit+ | Steering Mode=Active |

Table 5

$$\text{RMS Vehicle Acceleration-G(m/s/s)} = \sqrt{\sum \frac{Acc[n]^2}{n}}$$

Table 6

| | |
|---|---|
| T cycle = 60s<br>T monitor = 50s<br>T process = 10s | Calculate Parameters<br>Test & Issue Warnings<br>Update Screen Display<br>Store Sensor Data > Disk<br>Store Calculated Parameters > Disk |

Table 7

Note:

Data storage @ 1Hz
ZeroAcc=Average {RawAcc[n]}
ZeroWheel=Average {RawWheel[n]}
Ch(N)=Raw ADC Value (bit)

Table 8

Acc[n] = Kacc/1000 x (RawAcc[n]-ZeroAcc)x1/Cos(Alpha)

(m/s/s)  (mm/s/s/bit)          (blt)     (blt)


Wheel[n] = ArcSin [ Kwheel/(1000x9.81) x (RawWheel[n]-ZeroWheel)x1/Cos(Alpha)]

(Deg)              (mm/s/s/bit)              (bit)              (bit)


I = Klight/1000 x (Ch(2)-ZeroLight)

(KLx)  (Lx/bit)       (bit)      (bit)


T = Ktemp/1000 x (Ch(3) - ZeroTemp)

(DegC) (mDegC/blt) (bit)   (blt)

Table 9

| Engineering Scaling Factors | |
| --- | --- |
| K acc (mm/s/s/bit) | Acceleration Channel |
| K wheel (mm/s/s/bit) | Steering Channel |
| K light (Lx/bit) | Light Channel |
| K temp (mDegC/bit) | Temp Channel |
| | |
| ZeroLight (bit) | Intercept adjust - Light |
| ZeroTemp (bit) | Intercept adjust - Temp |
| | |
| Alpha (Deg) | Steering Wheel Inclination from Vertical |
| | |
| Hysterisis (Deg) | Hesterisis factor - Zero X analysis |

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Table 10

| Sleep Propensity Algorithm - Definition |
| --- |

S mod=S circ + S zerox + S rms + S light + S temp + S sleep + S road + S trip

| Elemental | Bound Limit |
| --- | --- |
| S mod | $0 < S\ mod < 1$ |
| S circ | $0 < S\ circ < 1$ |
| S zerox = (F zerox/100) (Z ref-Z) | $0 < S\ zerox$ |
| S rms = (F rms/100) (R-R ref) | $0 < S\ rms$ |
| S light = (F light/100) (I ref -I) | $0 < S\ light$ |
| S temp = (F temp/100) (T -T ref) | $0 < S\ temp$ |
| S sleep = (F sleep/100) (H ref - (HxQ)) | $0 < S\ sleep$ |
| S road = (F road/100) (G ref -G) | $0 < S\ road$ |
| S trip = (F trip/100) x D | $0 < S\ trip$ |

Table 11

| Algorithm Elementals - S | |
| --- | --- |
| S mod (S) | Modified Sleep Propensity Factor-Range 0...1 |
| S circ (S) | Current Circadian Sleep Propensity Value |
| S zerox (S) | Current Corrective Steering Reversal Rate Deficit |
| S rms (S) | Current RMS Corrective Steering Amplitude Surfit |
| S light (S) | Current Ambient Lighting Intensity Deficit |
| S temp (S) | Current Ambient Temperature Surfit |
| S sleep (S) | Prior Sleep Good Hours Deficit |
| S road (S) | Current Road Activity Deficit |
| S trip (S) | Accumulated Trip Duration |

Table 12

| Algorithm Weighting Factors - F |
| --- |
| Note : Factors are % S Unit per Parameter Unit |
| F zerox (%S/#/min)     Corrective Steering Reversal Rate Deficit - % Factor |
| F rms (%S/Deg)     RMS Corrective Steering Amplitude Surfit - % Factor |
| F light (%S/kLx)     Average Ambient Lighting Intensity Deficit - % Factor |
| F temp (%S/DegC)     Average Ambient Temperature Surfit - % Factor |
| F sleep (%S/Hr)     Prior to Good Hours Sleep Deficit - % Factor |
| F road (%S/m/s/s)     Road Activity Deficit - % Factor |
| F trip (%S/Hr)     Accumulated Trip Duration - % Factor |

Table 13

| Algorithm Reference Offfsets - ref |
| --- |
| Z ref (#/min)     Corrective Steering Reversal Rate - Ref Offset |
|     Corresponds to 'Alert ' Driving Subject Dependent |
| R ref (Deg)     Corrective Steering RMS Amplitude - Ref Offset |
|     Corresponds to 'Alert ' Driving Subject Dependent |
| I ref (kLx)     Average Ambient Lighting Intensity - Ref Offset |
|     Corresponds to moderate daylight |
| T ref (DegC)     Average Ambient Temperature - Ref Offset |
|     Corresponds to moderate environment |
| H ref (Hr)     Prior to Good Hours Sleep - Ref Offset |
|     Corresponds to optimum value |
| G ref (m/s/s)     Road Activity - RMS Acceleration / Deceleration - Ref Offset |

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Table 14

| Algorithm Dynamic Variables |  |
|---|---|
| Z (#/min) | Current Corrective Steering Zero X Rate |
| R (Deg) | Current RMS Correvtive Steering Amplitude |
| I (kLx) | Current Ambient Lighting Intensity |
| T(DegC) | Current Ambient Temperature |
| G (m/s/s) | Current Road Activity - RMS Acceleration / Deceleration |
| D(Hr) | Accumulated Trip Duration |
| H(Hr) | Actual Hours of Prior Sleep |
| Q (#) | Prior Sleep Quality - Normalised Scale 0...1 |
| Qx (#) | Prior Sleep Quality |
|  | User Scale 1,2,3,4,5 |
|  | $Q=Qx/5$ |

Table 15

| Steering Mode & Steering Limit -W limit |  |
|---|---|
| W limit (Deg) | Decision limit - Steering mode detection |
|  | +W limit >W> -W limit >>> Corrective |
|  | +W limit <W< -W limit >>> Active |
| Steering Mode | Steering mode decision |
|  | ACTIVE. CORRECTIVE |

Table 16

| Alarm Levels & Alarm State |  |
|---|---|
| Alarm Level 1 (s) | Alarm level threshold |
| Alarm Level 2 (s) | Alarm level threshold |
| Alarm Level 3 (s) | Alarm level threshold |
| Alarm Holdoff (min) | Initial alarm forced hold-off time - N minutes |
| Alarm State | Alarm status decision |
|  | CLEAR, LEVEL1, LEVEL2, LEVEL3, HOLDOFF |

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Table 17

| User Software Functions |
| --- |
| **Set Display Parameters** |
| Enter New Values and <RET> or <RET> to bypass edit option. |
| Display History (min)    Graphic display history length - Last N minutes |
| FSD (S)                  Graphic display full scale - S unit (0.. 1) |

Table 18

**Data Directiory Structure**

[ALGO] *.ALG
Algorithm Data Files - Internal Format

[USER]*.ALG
User Data Files - Internal Format

[XALGO]*.CSV
Algorithm Data Files - CSV Format

[XUSER]*.CSV
User Data Files - CSV Format

[XDRIVE]*.CSV
Drive Mode Data Files - CSV Format

[XLEARN]*.CSV
Learn Mode Data Files - CSV Format

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Table 19

| File Structure - Program Internal Format |
|---|
| Note : These files in program internal readable format |
| Configuration File - SLEEPALT.CFG |
| Save Set Values @ Program Shut Down |
| Load Set Value @ Program Initialisation |
| |
| K acc    (mm/s/s/bit) |
| K wheel  (mm/s/s/bit) |
| K light   (Lx/bit) |
| K temp   (mDegC/bit) |
| K batt    (mV/bit) |
| |
| ZeroLight      (bit) |
| ZeroTemp     (bit) |
| |
| Hysterysis    (Deg) |
| |
| Alpha         (Deg) |
| |
| AlgorithmID |
| |
| UserID |
| |
| Circ[0] ... [23]   (S) |
| |
| FSD        (0.. 1) |
| |
| DisplayHist   (min) |

Table 20

| Algorithm Data File [ALGO]*.ALG |
| --- |
| F zerox  (%S/#/min) |
| F rms    (%S/Deg) |
| F light  (%S/Klx) |
| F temp   (%S/DegC) |
| F sleep  (%S/Hr) |
| F road   (%S/m/s/s) |
| F trip   (%s/Hr) |
| |
| Z ref    (#/min) |
| R ref    (Deg) |
| I ref    (KLx) |
| T ref    (DegC) |
| H ref    (Hr) |
| G ref    (m/s/s) |
| |
| Alarm1   (s) |
| Alarm2   (s) |
| Alarm3   (s) |
| |
| AlarmHoldoff (min) |
| W limit (Deg) |

Table 21

| User Data File [USER]*.USR |
| --- |
| UserName |
| UserDoB |
| UserSex |

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Table 22

**Data File Structure - Drive Mode Data File [XDRIVE]*.CSV**
Note: These files in external readable format - CSV

DriveID
File Ceation Date
Start Time (Hr 0.. 23)
Start Time (min 0.. 59)
UserID
AlgorithmID

Alarm1 (s)
Alarm2 (s)
Alarm3 (s)
AlarmHoldOff (min)

W limit (Deg)

H (Hr)
Q (0.. 1)

| | | | |
|---|---|---|---|
| F zerox (%S/#/min) | | | |
| F rms (%S/Deg) | Z | (#/min) | |
| F light (%S/kLx) | R | (Deg) | |
| F temp (%S/DegC) | I | (KLx) | |
| F sleep (%S/Hr) | T | (DegC) | |
| F road (%S/m/s/s) | G | (m/s/s) | |
| F trip (%S/Hr) | D | (Hr) | |

| | | |
|---|---|---|
| Z ref | (#/min) | |
| R ref | (Deg) | |
| I ref | (Kix) | S mod (S) |
| T ref | (DegC) | S circ (S) |
| H ref | (Hr) | S zerox (S) |
| G ref | (m/s/s) | S rms (S) |
| | | S temp (S) |
| Minute Count (min) ........................... Repeat 1 .. N(min) | | S sleep (S) |
| AlarmState | | S road (S) |
| SteeringMode | | S trip (S) |
| Acceleration [1](m/s/s) Wheel[1](Deg) | | |
| | | DQC (Data Quality Code 0..255) |
| Acceleration [50] Wheel[50] | | |

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Table 23

**Data File Structure - Learn Mode Data File [XLEARN]*.CSV**

Note : These files in external readable format - CSV


**Data File Structure - User Data File [XUSER]*.CSV**

Note : These files in external readable format - CSV

UserID
File Creation Date

UserName
UserDoB
UserSex

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Table 24

**Data File Structure - Algorithm Data File [XALGO]*.CSV**

Note : These files in external readable format - CSV

AlgorithmID

File Creation Date

F zerox  (%S/#/min)

F rms (%S/Deg)

F light (%S/kLx)

F temp (%S/DegC)

F sleep (%S/Hr)

F road (%S/m/s/s)

F trip (%S/Hr)

Z ref        (#/min)

R ref        (Deg)

I ref        (KLx)

T ref        (DegC)

H ref        (Hr)

G ref        (m/s/s)

Alarm1 (s)

Alarm2 (s)

Alarm3 (s)

AlarmHoldOff (min)

W limit (Deg)

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